UNCLASSIFIED

Information Science and Technology Seminar Speaker Series

Robert D. Ryne
Lawrence Berkeley National Laboratory

Large-Scale Simulation of 3D Radiative Phenomena using a Lienard-Wiechert Particle-Mesh Method

Wednesday, January 21, 2015

3:00 - 4:00 PM

TA-3, Bldg. 1690, Room 102 (CNLS Conference Room)

Abstract: The proceedings of the 1971 International Conference on High Energy Accelerators record the comment that, "Now we are at the beginning of a new kind of extension by machine: the computer comes to supplement the theoretician's brain. We cannot foresee what this [new] kind of creativity in physics will bring..." At that time the fastest computer in the world was the CDC 7600, with a performance of about 10 MFLOPS. Now we are in the ~10 PFLOP era, with performance 1 billion times that of the 7600. Large-scale simulation has now become an indispensible tool in many fields -- a tool for exploration, understanding, optimization, and discovery.

In this talk I will describe the impact of this "new kind of creativity" to modeling beams and plasmas, although the techniques discussed have applications to many fields. Topics will include computational methods and algorithms, parallelization, visualization, and code calibration and validation. I will highlight several pioneering contributions made by LANL researchers. In regard to algorithms and methods, I will discuss several topics including Lie methods for modeling nonlinear dynamical systems, symplectic integration, split-operator techniques for multi-physics modeling, convolution methods, and Integrated Green's Function methods.

Finally, I will present a new approach -- a Lienard-Wiechert Particle-Mesh (LWPM) method -- for modeling 3D radiative phenomena in parallel particle-in-cell codes.

Biography: Dr. Robert Ryne received his Ph.D. in Physics from the University of Maryland in 1987. He was a Staff Member at Lawrence Livermore National Laboratory from 1987-1991. He was a Staff Member at Los Alamos National Laboratory from 1991-2000. In the 1990s, using the CM-5 at the LANL Advanced Computing Laboratory, he pioneered the use of parallel computers for modeling beam dynamics in particle accelerators. During this time he was also head of the Los Alamos Accelerator Code Group. He co-led the DOE Grand Challenge in Computational Accelerator Physics and the first DOE SciDAC accelerator modeling project. He led the development of the original IMPACT beam dynamics code. He joined Lawrence Berkeley National Laboratory in 2001. He led the development of the MaryLie/IMPACT code for multi-physics modeling including high-order optical effects and space-charge effects. Starting in 2009, with colleagues at LANL, he turned his attention from space-charge effects to radiation effects. He developed massively parallel codes for modeling synchrotron radiation phenomena. Since 2012 he has been the Level 1 Manager for Design & Simulation for the US DOE Muon Accelerator Program. Dr. Ryne is an active member of the computational accelerator physics community and the scientific computing community. He served as Chair of the NERSC User Group from 2002-2004. He was Chair and head organizer of the 2009 International Computational Accelerator Physics conference. He has taught Computational Methods at several sessions of the US Particle Accelerator School. He is a member of the American Physical Society, Division of Physics of Beams and Division of Computational Physics.

For more information contact the technical host Frank Alexander, fja@lanl.gov, 665-4518.

Hosted by the Information Science and Technology Institute (ISTI)

Los Alamos NATIONAL LABORATORY EST. 1943

ISTI INFORMATION SCIENCE & TECHNOLOGY INSTITUTE